



A longitudinal study on gross motor development in children with learning disorders



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ABSTRACT

This longitudinal study examined the development of gross motor skills, and sex-differences therein, in 7- to 11-years-old children with learning disorders (LD) and compared the results with typically developing children to determine the performance level of children with LD.

In children with LD ($n = 56$; 39 boys, 17 girls), gross motor skills were assessed with the Test of Gross Motor Development-2 and measured annually during a 3-year period. Motor scores of 253 typically developing children (125 boys, 112 girls) were collected for reference values.

The multilevel analyses showed that the ball skills of children with LD improved with age ($p < .001$), especially between 7 and 9 years, but the locomotor skills did not ($p = .50$). Boys had higher ball skill scores than girls ($p = .002$) and these differences were constant over time. Typically developing children outperformed the children with LD on the locomotor skills and ball skills at all ages, except the locomotor skills at age 7. Children with LD develop their ball skills later in the primary school-period compared to typically developing peers. However, 11 year-old children with LD had a lag in locomotor skills and ball skills of at least four and three years, respectively, compared to their peers.

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1. Introduction

Children typically attain proficiency in gross motor skills such as running, hopping, throwing, and catching during their primary school years through a process of maturation and practice (Davies & Rose, 2000; Gabbard, 2008). These are all basic skills that help children function as fully and as independently as possible in their surroundings (Pangrazi, 2007) and are commonly considered the building blocks for the development of more complex motor and sport-specific skills (Stodden et al., 2008; Wall, 2004). Additionally, gross motor skills are positively related to children's cognitive functioning, e.g. academic achievement and executive functioning (Lopes, Santos, Pereira, & Lopes, 2013; Murray et al., 2006; Piek, Dawson,

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Smith, & Gasson, 2008). Thus, sufficiently developed gross motor skills are thought to boost children's participation in physical activities and sports as well as the development of their cognitive abilities.

It has been shown that primary-school-age children with learning disorders¹ (LD) have inferior gross motor skills compared to typically developing peers (Simons, Daly, Theodorou, Caron, Simons, & Andoniadou, 2008; Westendorp, Hartman, Houwen, Smith, & Visscher, 2011b; Westendorp, Houwen, Hartman, & Visscher, 2011a). However, far less is known about the gross motor development of children with LD during the primary-school years. One cross-sectional study in children with mild intellectual disabilities (a subgroup of children with LD), ages 7–10 years, showed a positive age effect with small effect sizes for ball skills. No age effects were found for locomotor skills (Simons et al., 2008). Longitudinal research considering the development of gross motor skills in children with LD has not yet been conducted. Longitudinal research is important as it provides information about within-individual changes with age rather than changes between different individuals. Identifying possible developmental changes in gross motor skill performance in children with LD will give insight into possible accelerations or stabilization in the development. This knowledge is crucial as it is likely to provide clues for interventions directed at improving motor performance in this population.

Besides age, sex differences may play a role in the gross motor skill development of children with LD. Sex differences in gross motor skill development have been established in typically developing children. The ball skill scores of boys generally exceeded that of girls (Barnett, van Beurden, Morgan, Brooks, & Beard, 2010; Butterfield, Angell, & Mason, 2012), but boys and girls did not differ in their locomotor skill scores (Barnett et al., 2010; Ulrich, 2000). In children with LD mixed results have been found regarding sex differences in gross motor skill performance. Simons et al. (2008) found that boys outperformed girls in ball skills, however, Woodard and Surburg (1997) reported higher scores for boys on both locomotor skills and ball skills compared to girls. Until now, it is still unknown whether the developmental trajectory of gross motor skills is different for boys and girls with LD. This information is important whether or not interventions should be different for boys and girls.

In sum, it is generally agreed that children with LD have lower gross motor skill performance compared to typically developing children. However, no studies focused on the developmental trajectory of gross motor skills using longitudinal research. Insight in the longitudinal development of gross motor skills contribute to the current knowledge about the gross motor skill performance in children with LD.

The aim of this longitudinal study was, therefore, to chart the developmental trajectory of gross motor skills (i.e. locomotor skills and ball skills), and sex-differences therein, in 7- to 11-year-old children with LD and to compare the results with typically developing children to determine the performance level of children with LD. Based on the developmental skill-learning gap hypothesis (Wall, 2004), we hypothesized that the gap between children with LD and their more competent peers becomes wider. Children with a normal or high gross motor proficiency begin to use their motor skills in more open and complex settings, whereas children with less adequately developed gross motor skills find it difficult to participate in these complex settings, making it more difficult for them to acquire the expertise they require to participate (Wall, 2004). Given that children with LD tend to have poorer gross motor skills than their typically developing peers, the gap between the two groups may become larger with age.

2. Material and methods

2.1. Participants

Fifty-six children with LD (39 boys and 17 girls), aged between 7 and 11 years old in the year of enrolment, participated in this longitudinal study. They were recruited from a special-needs primary school located in the northern Netherlands. Over a period of three years children's gross motor skills were measured annually in January. Not all 56 children participated in all three measurements, as some children enrolled in the school during the 3-year period, some others left or were absent due to illness. Thirty-five children performed all three measurements, 16 children performed two measurements, and five children were assessed one time. An overview of the numbers of children per measurement per age group is given in Table 1, with a total of 142 measurements.

For each child, the individual school files containing information about child characteristics (e.g. age, sex, IQ), a short medical history, and comorbid disorders were screened. Fifteen children had a comorbid disorder, i.e. 9 children were diagnosed as having Attention Deficit Hyperactivity Disorder, 3 children were diagnosed as having Autism Spectrum Disorders, and 3 children were diagnosed with both. The children's mean intelligence quotient was 84.2 (SD 11.0; range 60–109).

To determine the performance level of children with LD, 253 typically developing peers (125 boys and 112 girls), attending two mainstream schools in the same region, were included in the present study to provide reference values. The age range of the children was 7–11 years (mean age 9.5 years; SD 1.2) and children's grade level was appropriate to their age, indicating that their ability on academic performance was in the normal range (i.e. the expected level in relation to their learning experiences).

¹ Children with learning disorders are defined here as children with problems in academic skills like reading and mathematics that attend Dutch special-needs primary schools.

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